10,000
FORMULAS

Acid-Proofing

An Acid-Proof Table Top.—

1.

Copper sulphate.....	1 part
Potassium chlorate....	1 part
Water.....	8 parts

Boil until salts are dissolved.

2.

Aniline hydrochlorate.	3 parts
Water.....	20 parts

Or, if more readily procurable:

Aniline.....	6 parts
Hydrochloric acid.....	9 parts
Water.....	50 parts

By the use of a brush two coats of solution No. 1 are applied while hot; the second coat as soon as the first is dry. Then two coats of solution No. 2, and the wood allowed to dry thoroughly. Later, a coat of raw linseed oil is to be applied, using a cloth instead of a brush, in order to get a thinner coat of the oil.

A writer in the *Journal of Applied Microscopy* states that he has used this method upon some old laboratory tables which had been finished in the usual way, the wood having been filled, oiled, and varnished. After scraping off the varnish down to the wood, the solutions were applied, and the result was very satisfactory.

After some experimentations the formula was modified without materially affecting the cost, and apparently increasing the resistance of the wood to the action of strong acids and alkalies. The modified formula follows:

1.

Iron sulphate.....	4 parts
Copper sulphate.....	4 parts
Potassium permanganate.....	8 parts
Water, q. s.....	100 parts

2.

Aniline.....	12 parts
Hydrochloric acid....	18 parts
Water, q. s.....	100 parts

Or:

Aniline hydrochlorate	15 parts
Water, q. s.....	100 parts

Solution No. 2 has not been changed, except to arrange the parts per hundred.

The method of application is the same, except that after solution No. 1 has dried, the excess of the solution which has dried upon the surface of the wood is thoroughly rubbed off before the application of solution No. 2. The black color does not appear at once, but usually requires a few hours before becoming ebony black. The linseed oil may be diluted with turpentine without disadvantage, and after a few applications the surface will take on a dull and not displeasing polish. The table tops are easily cleaned by washing with water or suds after a course of work is completed, and the application of another coat of oil puts them in excellent order for another course of work. Strong acids or alkalies when spilled, if soon wiped off, have scarcely a perceptible effect.

A slate or tile top is expensive not only in its original cost, but also as a destroyer of glassware. Wood tops when painted, oiled, or paraffined have objectionable features, the latter especially in warm weather. Old table tops, after the paint or oil is scraped off down to the wood, take the above finish nearly as well as the new wood.

To Make Wood Acid- and Chlorine-Proof.—Take 6 pounds of wood tar and 12 pounds rosin, and melt them together in an iron kettle, after which stir in 8 pounds finely powdered brick dust. The damaged parts must be cleaned perfectly and dried, whereupon they may be painted over with the warm preparation or filled up and drawn off, leaving the film on the inside.

Protecting Cement Against Acid.—A paint to protect cement against acid is obtained by mixing pure asbestos, very finely powdered, with a thick solution of

sodium silicate. The sodium silicate must be as alkaline as possible. The asbestos is first rubbed with a small quantity of the silicate, until a cake is obtained and then kept in well-closed vessels. For use this cake is simply thinned with a solution of the silicate, which furnishes a paint two or three applications of which protect the walls of reservoirs, etc., against any acid solid or liquid. This mass may also be employed for making a coating of sandstone.

To Make Corks Impermeable and Acid-Proof.—Choose your corks carefully. Then plunge them into a solution of gelatin or common glue, 15 parts, in 24 parts of glycerine and 500 parts of water, heated to 44° or 48° C. (112°–120° F.), and keep them there for several hours. On removing the corks, which should be weighted down in the solution, dry them in the shade until they are free from all surplus moisture. They are now perfectly tight, retaining at the same time the greater portion of their elasticity and suppleness. To render them acid-proof, they should be treated with a mixture of vaseline, 2 parts, and paraffine 7 parts, heated to about 105° F. This second operation may be avoided by adding to the gelatin solution a little ammonium dichromate and afterwards exposing the corks to the light.

Lining for Acid Receptacles.—Plates are formed of 1 part of brown slate, 2 of powdered glass, and 1 of Portland cement, the whole worked up with silicate of soda, molded and dried. Make a cement composed of ground slate and silicate of soda and smear the surface for the lining; then, while it is still plastic, apply the plates prepared as above described. Instead of these plates, slabs of glass or porcelain or similar substances may be employed with the same cement.

ACACIA, MUCILAGE OF:
See Adhesives under Mucilages.

ACID-PROOF GLASS:
See Glass.

ACID-RESISTING PAINT:
See Paint.

ADHESIVE PLASTER, TO REMOVE WITHOUT PAIN:

Oil of wintergreen applied to adhesive plaster will completely destroy its adhesive power in a short time. It is necessary to use only a small amount of the oil, which is applied directly to the plaster and easily spreads itself throughout the adhesive material.

Adhesives

GLUES:

Manufacture of Glue.—I.—The usual process of removing the phosphate of lime from bones for glue-making purposes by means of dilute hydrochloric acid has the disadvantage that the acid cannot be regenerated. Attempts to use sulphurous acid instead have so far proved unsuccessful, as, even with the large quantities used, the process is very slow. According to a German invention this difficulty with sulphurous acid can be avoided by using it in aqueous solution under pressure. The solution of the lime goes on very rapidly, it is claimed, and no troublesome precipitation of calcium sulphite takes place. Both phosphate of lime and sulphurous acid are regenerated from the lyes by simple distillation.

II.—Bones may be treated with successive quantities of combined sulphurous acid and water, from which the heat of combination has been previously dissipated, the solution being removed after each treatment, before the bone salts dissolved therein precipitate, and before the temperature rises above 74° F.—U. S. Pat. 783,784.

III.—A patent relating to the process for treating animal sinews, preparatory for the glue factory, has been granted to Florsheim, Chicago, and consists in immersing animal sinews successively in petroleum or benzine to remove the outer fleshy animal skin; in a hardening or preserving bath, as boric acid, or alum or copper sulphate; and in an alkaline bath to remove fatty matter from the fibrous part of the sinews. The sinews are afterwards tanned and disintegrated.

Test for Glue.—The more water the glue takes up, swelling it, the better it is. Four ounces of the glue to be examined are soaked for about 12 hours in a cool place in 4 pounds of cold water. If the glue has dissolved after this time, it is of bad quality and of little value; but if it is coherent, gelatinous, and weighing double, it is good; if it weighs up to 16 ounces, it is very good; if as much as 20 ounces, it may be called excellent.

To Prevent Glue from Cracking.—To prevent glue from cracking, which frequently occurs when glued articles are

exposed to the heat of a stove, a little chloride of potassium is added. This prevents the glue from becoming dry enough to crack. Glue thus treated will adhere to glass, metals, etc., and may also be used for pasting on labels.

Preventing the Putrefaction of Strong Glues.—The fatty matter always existing in small quantity in sheets of ordinary glue affects the adhesive properties and facilitates the development of bacteria, and consequently putrefaction and decomposition. These inconveniences are remedied by adding a small quantity of caustic soda to the dissolved glue. The soda prevents decomposition absolutely; with the fatty matter it forms a hard soap which renders it harmless.

Liquid Glues.—

I.—Glue	3	ounces
Gelatin	3	ounces
Acetic acid	4	ounces
Water	2	ounces
Alum	30	grains

Heat together for 6 hours, skim, and add:

II.—Alcohol	1	fluidounce
Brown glue, No. 2	2	pounds
Sodium carbonate	11	ounces
Water	3½	pints
Oil of clove	160	minims

Dissolve the soda in the water, pour the solution over the dry glue, let stand over night or till thoroughly soaked and swelled, then heat carefully on a water bath until dissolved. When nearly cold stir in the oil of cloves.

By using white glue, a finer article, fit for fancy work, may be made.

III.—Dissolve by heating 60 parts of borax in 420 parts of water, add 480 parts dextrin (pale yellow) and 50 parts of glucose and heat carefully with continued stirring, to complete solution; replace the evaporated water and pour through flannel.

The glue made in this way remains clear quite a long time, and possesses great adhesive power; it also dries very quickly, but upon careless and extended heating above 90° C. (194° F.), it is apt to turn brown and brittle.

IV.—Pour 50 parts of warm (not hot) water over 50 parts of Cologne glue and allow to soak over night. Next day the swelled glue is dissolved with moderate heat, and if still too thick, a little more water is added. When this is done, add from 2½ to 3 parts of crude nitric acid, stir well, and fill the liquid glue in well-corked bottles. This is a good liquid steam glue.

V.—Soak 1 pound of good glue in a quart of water for a few hours, then melt the glue by heating it, together with the unabsorbed water, then stir in ½ pound dry white lead, and when that is well mixed pour in 4 fluidounces of alcohol and continue the boiling 5 minutes longer.

VI.—Soak 1 pound of good glue in 1½ pints of cold water for 5 hours, then add 3 ounces of zinc sulphate and 2 fluidounces of hydrochloric acid, and keep the mixture heated for 10 or 12 hours at 175° to 190° F. The glue remains liquid and may be used for sticking a variety of materials.

VII.—A very inexpensive liquid glue may be prepared by first soaking and then dissolving gelatin in twice its own weight of water at a very gentle heat; then add glacial acetic acid in weight equal to the weight of the dry gelatin. It should be remembered, however, that all acid glues are not generally applicable.

VIII.—Glue	200	parts
Dilute acetic acid	400	parts

Dissolve by the aid of heat and add:

Alcohol	25	parts
Alum	5	parts
IX.—Glue	5	parts
Calcium chloride	1	part
Water	1	part
X.—Sugar of lead	1½	drachms
Alum	1½	drachms
Gum arabic	2½	drachms
Wheat flour	1	av. lb.
Water, q. s.		

Dissolve the gum in 2 quarts of warm water; when cold mix in the flour, and add the sugar of lead and alum dissolved in water; heat the whole over a slow fire until it shows signs of ebullition. Let it cool, and add enough gum water to bring it to the proper consistence.

XI.—Dilute 1 part of official phosphoric acid with 2 parts of water and neutralize the solution with carbonate of ammonium. Add to the liquid an equal quantity of water, warm it on a water bath, and dissolve in it sufficient glue to form a thick syrupy liquid. Keep in well-stoppered bottles.

XII.—Dissolve 3 parts of glue in small pieces in 12 to 15 of saccharate of lime. By heating, the glue dissolves rapidly and remains liquid, when cold, without loss of adhesive power. Any desirable consistence can be secured by varying the amount of saccharate of lime. Thick glue retains its muddy color, while a thin solution becomes clear on standing.

The saccharate of lime is prepared by

dissolving 1 part of sugar in 3 parts of water, and after adding ¼ part of the weight of the sugar of slaked lime, heating the whole from 149° to 185° F., allowing it to macerate for several days, shaking it frequently. The solution, which has the properties of mucilage, is then decanted from the sediment.

XIII.—In a solution of borax in water soak a good quantity of glue until it has thoroughly imbibed the liquid. Pour off the surplus solution and then put on the water bath and melt the glue. Cool down until the glue begins to set, then add, drop by drop, with agitation, enough acetic acid to check the tendency to solidification. If, after becoming quite cold, there is still a tendency to solidification, add a few drops more of the acid. The liquid should be of the consistence of ordinary mucilage at all times.

XIV.—Gelatin	100 parts
Cabinetmakers' glue.	100 parts
Alcohol	25 parts
Alum	2 parts
Acetic acid, 20 per cent	800 parts

Soak the gelatin and glue with the acetic acid and heat on a water bath until fluid; then add the alum and alcohol.

XV.—Glue	10 parts
Water	15 parts
Sodium salicylate	1 part

XVI.—Soak 5 parts of Cologne glue in an aqueous calcium chloride solution (1 : 4) and heat on the water bath until dissolved, replacing the evaporating water; or slack 100 parts of lime with 150 parts of hot water, dissolve 60 parts of sugar in 180 parts of water, and add 15 parts of the slacked lime to the solution, heating the whole to 75° C. (167° F.). Place aside for a few days, shaking from time to time. In the clear sugar-lime solution collected by decanting soak 60 parts of glue and assist the solution by moderate heating.

XVII.—Molasses, 100 parts, dissolved in 300 parts of water, 25 parts of quicklime (slaked to powder), being then stirred in and the mixture heated to 167° F. on a water bath, with frequent stirrings. After settling for a few days a large portion of the lime will have dissolved, and the clear, white, thick solution, when decanted, behaves like rubber solution and makes a highly adherent coating.

XVIII.—Dissolve bone glue, 250 parts, by heating in 1,000 parts of water, and add to the solution barium peroxide 10 parts, sulphuric acid (66° B.) 5 parts, and water 15 parts. Heat for 48 hours on the water bath to 80° C. (176° F.). Thus a syrupy liquid is obtained, which is allowed to settle and is then decanted. This glue has no unpleasant odor, and does not mold.

XIX.—A glue possessing the adhesive qualities of ordinary joiners' glue, but constituting a pale yellow liquid which is ready for use without requiring heating and possesses great resistance to dampness, is produced by treating dry casein with a diluted borax solution or with enough ammonia solution to cause a faintly alkaline reaction. The preparation may be employed alone or mixed with liquid starch in any proportion.

Glue for Celluloid.—I.—Two parts shellac, 3 parts spirits of camphor, and 4 parts strong alcohol dissolved in a warm place, give an excellent gluing agent to fix wood, tin, and other bodies to celluloid. The glue must be kept well corked up.

II.—A collodion solution may be used, or an alcoholic solution of fine celluloid shavings.

Glue to Form Paper Pads.—

I.—Glue	3½ ounces
Glycerine	8 ounces
Water, a sufficient quantity.	

Pour upon the glue more than enough water to cover it and let stand for several hours, then decant the greater portion of the water; apply heat until the glue is dissolved, and add the glycerin. If the mixture is too thick, add more water.

II.—Glue	6 ounces
Alum	30 grains
Acetic acid	½ ounce
Alcohol	1½ ounces
Water	6½ ounces

Mix all but the alcohol, digest on a water bath till the glue is dissolved, allow to cool and add the alcohol.

III.—Glue	5 ounces
Water	1 ounce
Calcium chloride	1 ounce

Dissolve the calcium chloride in the water, add the glue, macerate until it is thoroughly softened, and then heat until completely dissolved.

IV.—Glue	20 ounces
Glycerine	5 ounces
Syrupy glucose	1 ounce
Tannin	50 grains

Cover the glue with cold water, and let stand over night. In the morning pour off superfluous water, throw the glue on muslin, and manipulate so as to get rid of as much moisture as possible, then put in a water bath and melt. Add the glyc

erine and syrup, and stir well in. Finally, dissolve the tannin in the smallest quantity of water possible and add.

This mixture must be used hot.

V.—Glue	15 ounces
Glycerine	5 ounces
Linseed oil	2 ounces
Sugar	1 ounce

Soak the glue as before, melt, add the sugar and glycerine, continuing the heat, and finally add the oil gradually under constant stirring.

This must be used hot.

Glue for Tablets.—

I.—Glue	3½ ounces
Glycerine	8 ounces
Water, a sufficient quantity.	

Pour upon the glue more than enough water to cover it and let stand for several hours, then decant the greater portion of the water; apply heat until the glue is dissolved, and add the glycerine. If the mixture is too thick, add more water.

II.—Glue	6 ounces
Alum	30 grains
Acetic acid	½ ounce
Alcohol	1½ ounces
Water	6½ ounces

Mix all but the alcohol, digest on a water bath till the glue is dissolved, allow to cool and add the alcohol.

III.—Glue	5 ounces
Water	1 ounce
Calcium chloride	1 ounce

Dissolve the calcium chloride in the water, add the glue, macerate until it is thoroughly softened, and then apply heat until completely dissolved.

IV.—Glue, 1 pound; glycerine, 4 ounces; glucose syrup, 2 tablespoonfuls; tannin, ½ ounce. Use warm, and give an hour to dry and set on the pads. This can be colored with any aniline dye.

Marine Glue.—Marine glue is a product consisting of shellac and caoutchouc, which is mixed differently according to the use for which it is required. The quantity of benzol used as solvent governs the hardness or softness of the glue.

I.—One part Pará caoutchouc is dissolved in 12 parts benzol; 20 parts powdered shellac are added to the solution, and the mixture is carefully heated.

II.—Stronger glue is obtained by dissolving 10 parts good crude caoutchouc in 120 parts benzine or naphtha which solution is poured slowly and in a fine stream into 20 parts asphaltum melted in a kettle, stirring constantly and heating. Pour the finished glue, after the solvent has almost evaporated and the mass has become quite uniform, into flat molds, in which it solidifies into very hard tablets of dark brown or black color. For use, these glue tablets are first soaked in boiling water and then heated over a free flame until the marine glue has become thinly liquid. The pieces to be glued are also warmed and a very durable union is obtained.

III.—Cut caoutchouc into small pieces and dissolve in coal naphtha by heat and agitation. Add to this solution powdered shellac, and heat the whole, constantly stirring until combination takes place, then pour it on metal plates to form sheets. When used it must be heated to 248° F., and applied with a brush.

Water-Proof Glues.—I.—The glue is put in water till it is soft, and subsequently melted in linseed oil at moderate heat. This glue is affected neither by water nor by vapors.

II.—Dissolve a small quantity of sandarac and mastic in a little alcohol, and add a little turpentine. The solution is boiled in a kettle over the fire, and an equal quantity of a strong hot solution of glue and isinglass is added. Then filter through a cloth while hot.

III.—Water-proof glue may also be produced by the simple addition of bichromate of potassium to the liquid glue solution, and subsequent exposure to the air.

IV.—Mix glue as usual, and then add linseed oil in the proportion of 1 part oil to 8 parts glue. If it is desired that the mixture remain liquid, ½ ounce of nitric acid should be added to every pound of glue. This will also prevent the glue from souring.

V.—In 1,000 parts of rectified alcohol dissolve 60 parts of sandarac and as much mastic whereupon add 60 parts of white oil of turpentine. Next, prepare a rather strong glue solution and add about the like quantity of isinglass, heating the solution until it commences to boil; then slowly add the hot glue solution till a thin paste forms, which can still be filtered through a cloth. Heat the solution before use and employ like ordinary glue. A connection effected with this glue is not dissolved by cold water and even resists hot water for a long time.

VI.—Soak 1,000 parts of Cologne glue in cold water for 12 hours and in another vessel for the same length of time 150 parts of isinglass in a mixture of lamp spirit and water. Then dissolve both masses together on the water bath in a suitable vessel, thinning, if necessary, with some hot water. Next add 100

parts of linseed oil varnish and filter hot through linen.

VII.—Ordinary glue is kept in water until it swells up without losing its shape. Thus softened it is placed in an iron crucible without adding water; then add linseed oil according to the quantity of the glue and leave this mixture to boil over a slow fire until a gelatinous mass results. Such glue unites materials in a very durable manner. It adheres firmly and hardens quickly. Its chief advantage, however, consists in that it neither absorbs water nor allows it to pass through, whereby the connecting places are often destroyed. A little borax will prevent putrefaction.

VIII.—Bichromate of potassium 40 parts (by weight); gelatin glue, 55 parts; alum, 5 parts. Dissolve the glue in a little water and add the bichromate of potassium and the alum.

IX.—This preparation permits an absolutely permanent gluing of pieces of cardboard, even when they are moistened by water. Melt together equal parts of good pitch and gutta-percha; of this take 9 parts, and add to it 3 parts of boiled linseed oil and 1½ parts of litharge. Place this over the fire and stir it till all the ingredients are intimately mixed. The mixture may be diluted with a little benzine or oil of turpentine, and must be warm when used.

Glue to Fasten Linoleum on Iron Stairs.—I.—Use a mixture of glue, isinglass, and dextrin which, dissolved in water and heated, is given an admixture of turpentine. The strips pasted down must be weighted with boards and brick on top until the adhesive agent has hardened.

II.—Soak 3 parts of glue in 8 parts water, add ½ part hydrochloric acid and ¾ part zinc vitriol and let this mixture boil several hours. Coat the floor and the back of the linoleum with this. Press the linoleum down uniformly and firmly and weight it for some time.

Glue for Attaching Gloss to Precious Metals.—Sandarac varnish, 15 parts; marine glue, 5 parts; drying oil, 5 parts; white lead, 5 parts; Spanish white, 5 parts; turpentine, 5 parts. Triturate all to form a rather homogeneous paste. This glue becomes very hard and resisting.

Elastic Glue.—Although elastic glue is less durable than rubber, and will not stand much heat, yet it is cheaper than rubber, and is not, like rubber affected by oil colors. Hence it is largely used for printing rollers and stamps. For stamps, good glue is soaked for 24 hours in soft water. The water is poured off, and the swollen glue is melted and mixed with glycerine and a little salicylic acid and cast into molds. The durability is increased by painting the mass with a solution of tannin, or, better, of bichromate of potassium. Printing rollers require greater firmness and elasticity. The mass for them once consisted solely of glue and vinegar, and their manufacture was very difficult. The use of glycerine has remedied this, and gives great elasticity without adhesiveness, and has removed the liability of moldiness. Swollen glue, which has been superficially dried, is fused with glycerine and cast into oil molds. Similar mixtures are used for casting plaster ornaments, etc., and give very sharp casts. A mass consisting of glue and glycerine is poured over the model in a box. When the mold is removed, it is painted with plaster outside and with boiled oil inside, and can then be used many times for making reproductions of the model.

Glue for Paper and Metal.—A glue which will keep well and adhere tightly is obtained by diluting 1,000 parts by weight of potato starch in 1,200 parts by weight of water and adding 50 parts by weight of pure nitric acid. The mixture is kept in a hot place for 48 hours, taking care to stir frequently. It is afterwards boiled to a thick and transparent consistency, diluted with water if there is occasion, and then there are added in the form of a screened powder, 2 parts of sal ammoniac and 1 part of sulphur flowers.

Glue for Attaching Cloth Strips to Iron.—Soak 500 parts of Cologne glue in the evening with clean cold water in a clean vessel; in the morning pour off the water, place the softened glue without admixture of water into a clean copper or enamel receptacle, which is put on a moderate low fire (charcoal or steam apparatus). During the dissolution the mass must be continually stirred with a wooden trowel or spatula. If the glue is too thick, it is thinned with diluted spirit, but not with water. As soon as the glue has reached the boiling point, about 50 parts of linseed oil varnish (boiled oil) is added to the mass with constant stirring. When the latter has been stirred up well, add 50 parts of powdered colophony and shake it into the mass with stirring, subsequently removing the glue from the fire. In order to increase the binding qualities and to guard against moisture, it is well still to add about 50 parts of isinglass, which has been previously cut

into narrow strips and placed, well beaten, in a vessel, into which enough spirit of wine has been poured to cover all. When dissolved, the last-named mass is added to the boiling glue with constant stirring. The adhesive agent is now ready for use and is employed hot, it being advisable to warm the iron also. Apply glue only to a surface equivalent to a single strip at a time. The strips are pressed down with a stiff brush or a wad of cloth.

Glue for Leather or Cardboard.—To attach leather to cardboard dissolve good glue (softened by swelling in water) with a little turpentine and enough water in an ordinary glue pot, and then having made a thick paste with starch in the proportion of 2 parts by weight, of starch powder for every 1 part, by weight, of dry glue, mix the compounds and allow the mixture to become cold before application to the cardboard.

For Wood, Glass, Cardboard, and all Articles of a Metallic or Mineral Character.—Take boiled linseed oil 20 parts, Flemish glue 20 parts, hydrated lime 15 parts, powdered turpentine 5 parts, alum 5 parts acetic acid 5 parts. Dissolve the glue with the acetic acid, add the alum, then the hydrated lime, and finally the turpentine and the boiled linseed oil. Triturate all well until it forms a homogeneous paste and keep in well-closed flasks. Use like any other glue.

Glue for Uniting Metals with Fabrics.—Cologne glue of good quality is soaked and boiled down to the consistency of that used by cabinetmakers. Then add, with constant stirring, sifted wood ashes until a moderately thick, homogeneous mass results. Use hot and press the pieces well together during the drying. For tinfoil about 2 per cent of boracic acid should be added instead of the wood ashes.

Glue or Paste for Making Paper Boxes.—

Chloral hydrate.....	5 parts
Gelatin, white.....	8 parts
Gum arabic.....	2 parts
Boiling water.....	30 parts

Mix the chloral, gelatin, and gum arabic in a porcelain container, pour the boiling water over the mixture and let stand for 1 day, giving it a vigorous stirring several times during the day. In cold weather this is apt to get hard and stiff, but this may be obviated by standing the container in warm water for a few minutes. This paste adheres to any surface whatever.

Natural Glue for Cementing Porcelain, Crystal Glass, etc.—The large shell snails which are found in vineyards have at the extremity of their body a small, whitish bladder filled with a substance of greasy and gelatinous aspect. If this substance extracted from the bladder is applied on the fragments of porcelain or any body whatever, which are juxtaposed by being made to touch at all parts, they acquire such adhesion that if one strives to separate them by a blow, they are more liable to break at another place than the cemented seam. It is necessary to give this glue sufficient time to dry perfectly, so as to permit it to acquire the highest degree of strength and tenacity.

Belt Glue.—A glue for belts can be prepared as follows: Soak 50 parts of gelatin in water, pour off the excess of water, and heat on the water bath. With good stirring add, first, 5 parts, by weight, of glycerine, then 10 parts, by weight, of turpentine, and 5 parts, by weight, of linseed oil varnish and thin with water as required. The ends of the belts to be glued are cut off obliquely and warmed; then the hot glue is applied, and the united parts are subjected to strong pressure, allowing them to dry thus for 24 hours before the belts are used.

Chromium Glue for Wood, Paper, and Cloth.—I.—(*a*) One-half pound strong glue (any glue if color is immaterial, white fish glue otherwise); soak 12 hours in 12 fluidounces of cold water. (*b*) One-quarter pound gelatin; soak 2 hours in 12 fluidounces cold water. (*c*) Two ounces bichromate of potassium dissolved in 8 fluidounces boiling water. Dissolve (*a*) after soaking, in a glue pot, and add (*b*). After (*a*) and (*b*) are mixed and dissolved, stir in (*c*). This glue is exceedingly strong, and if the article cemented be exposed to strong sunlight for 1 hour, the glue becomes perfectly waterproof. Of course, it is understood that the exposure to sunlight is to be made after the glue is thoroughly dry. The one objectionable feature of this cement is its color, which is a yellow-brown. By substituting chrome alum in place of the bichromate, an olive color is obtained.

II.—Use a moderately strong gelatin solution (containing 5 to 10 per cent of dry gelatin), to which about 1 part of acid chromate of potassium in solution is added to every 5 parts of gelatin. This mixture has the property of becoming insoluble by water through the action of sunlight under partial reduction of the chromic acid.

Fireproof Glue.—

Raw linseed oil	8 parts
Glue or gelatin	1 part
Quicklime	2 parts

Soak the glue or gelatin in the oil for 10 to 12 hours, and then melt it by gently heating the oil, and when perfectly fluid stir in the quicklime until the whole mass is homogeneous, then spread out in layers to dry gradually, out of the sun's rays. For use, reheat the glue in a glue pot in the ordinary way of melting glue.

CEMENTS.

Under this heading will be found only cements for causing one substance to adhere to another. Cements used primarily as fillers, such as dental cements, will be found under Cements, Putties, etc.

Cutlers' Cements for Fixing Knife Blades into Handles.—

I.—Rosin	4 pounds
Beeswax	1 pound
Plaster of Paris or brickdust	1 pound
II.—Pitch	5 pounds
Wood ashes	1 pound
Tallow	1 pound

III.—Rosin, 12; sulphur flowers, 3; iron filings, 5. Melt together, fill the handle while hot, and insert the instrument.

IV.—Plaster of Paris is ordinarily used for fastening loose handles. It is made into a moderately thick paste with water run into the hole in the head of the pestle, the handle inserted and held in place till the cement hardens. Some add sand to the paste, and claim to get better results.

V.—Boil together 1 part of caustic soda, 3 parts of rosin, and 5 parts of water till homogeneous and add 4 parts of plaster of Paris. The paste sets in half an hour and is but little affected by water.

VI.—Equal quantities of gutta percha and shellac are melted together and well stirred. This is best done in an iron capsule placed on a sandbath and heated over a gas furnace or on the top of a stove. The combination possesses both hardness and toughness, qualities that make it particularly desirable in mending mortars and pestles. In using, the articles to be cemented should be warmed to about the melting point of the mixture and retained in proper position until cool, when they are ready for use.

VII.—Rosin	600	Parts by weight.
Sulphur	150	
Iron filings	250	

Pour the mixture, hot, into the opening of the heated handle and shove in the knife likewise heated.

VIII.—Melt sufficient black rosin, and incorporate thoroughly with it one-fifth its weight of very fine silver sand. Make the pestle hot, pour in a little of the mixture, then force the handle well home, and set aside for a day before using.

IX.—Make a smooth, moderately soft paste with litharge and glycerine; fill the hole in the pestle with the cement, and firmly press the handle in place, keeping it under pressure for three or four days.

Cements for Stone.—I.—An excellent cement for broken marble consists of 4 parts of gypsum and 1 part of finely powdered gum arabic. Mix intimately. Then with a cold solution of borax make into a mortarlike mass. Smear on each face of the parts to be joined, and fasten the bits of marble together. In the course of a few days the cement becomes very hard and holds very tenaciously. The object mended should not be touched for several days. In mending colored marbles the cement may be given the hue of the marble by adding the color to the borax solution.

II.—A cement which dries instantaneously, qualifying it for all sorts of repairing and only presenting the disadvantage of having to be freshly prepared each time, notwithstanding any subsequent heating, may be made as follows: In a metal vessel or iron spoon melt 4 to 5 parts of rosin (or preferably mastic) and 1 part of beeswax. This mixture must be applied rapidly, it being of advantage slightly to heat the surfaces to be united, which naturally must have been previously well cleaned.

III.—Slaked lime, 10 parts; chalk, 15 parts; kaolin, 5 parts; mix, and immediately before use stir with a corresponding amount of potash water glass.

IV.—Cement on Marble Slabs.—The whole marble slab is thoroughly warmed and laid face down upon a neatly cleaned planing bench upon which a woolen cloth is spread so as not to injure the polish of the slab. Next apply to the slab very hot, weak glue and quickly sift hot plaster of Paris on the glue in a thin even layer, stirring the plaster rapidly into the applied glue by means of a strong spatula, so that a uniform glue-plaster coating is formed on the warm slab. Before this has time to harden tip the respective piece of furniture on the slab. The frame, likewise warmed, will adhere very firmly to the slab after two days. Besides, this process has the advantage of great cleanliness.

V.—The following is a recipe used by marble workers, and which probably can be used to advantage: Flour of sulphur, 1 part; hydrochlorate of ammonia, 2 parts; iron filings, 16 parts. The above substances must be reduced to a powder, and securely preserved in closely stoppered vessels. When the cement is to be employed, take 20 parts very fine iron filings and 1 part of the above powder; mix them together with enough water to form a manageable paste. This paste solidifies in 20 days and becomes as hard as iron. A recipe for another cement useful for joining small pieces of marble or alabaster is as follows: Add ½ pint of vinegar to ½ pint skimmed milk; mix the curd with the whites of 5 eggs, well beaten, and sufficient powdered quicklime sifted in with constant stirring so as to form a paste. It resists water and a moderate degree of heat.

VI.—Cement for Iron and Marble.—For fastening iron to marble or stone a good cement is made as follows: Thirty parts plaster of Paris, 10 parts iron filings, ½ part sal ammoniac mixed with vinegar to a fluid paste fresh for use.

Cement for Sandstones.—One part sulphur and 1 part rosin are melted separately; the melted masses are mixed and 3 parts litharge and 2 parts ground glass stirred in. The latter ingredients must be perfectly dry, and have been well pulverized and mixed previously.

Equally good cement is obtained by melting together 1 part pitch and $\frac{1}{10}$ part wax, and mixing with 2 parts brickdust.

The stones to be cemented, or between the joints of which the putty is to be poured, must be perfectly dry. If practicable, they should be warmed a little, and the surfaces to which the putty is to adhere painted with oil varnish once or twice. The above two formulæ are of especial value in case the stones are very much exposed to the heat of the sun in summer, as well as to cold, rain, and snow in winter. Experience has shown that in these instances the above-mentioned cements give better satisfaction than the other brands of cement.

Cements for Attaching Objects to Glass.—

Rosin	1 part
Yellow wax	2 parts

Melt together.

To Attach Copper to Glass.—Boil 1 part of caustic soda and 3 parts of colophony in 5 parts of water and mix with the like quantity of plaster of Paris. This cement is not attacked by water, heat, and petroleum. If, in place of the plaster of Paris, zinc white, white lead, or slaked lime is used, the cement hardens more slowly.

To Fasten Brass upon Glass.—Boil together 1 part of caustic soda, 3 parts of rosin, 3 parts of gypsum, and 5 parts of water. The cement made in this way hardens in about half an hour, hence it must be applied quickly. During the preparation it should be stirred constantly. All the ingredients used must be in a finely powdered state.

Uniting Glass with Horn.—(1) A solution of 2 parts of gelatin in 20 parts water is evaporated up to one-sixth of its volume and ½ mastic dissolved in ½ spirit added and some zinc white stirred in. The putty is applied warm; it dries easily and can be kept a long time. (2) Mix gold size with the equal volume of water glass.

To Cement Glass to Iron.—

I.—Rosin	5 ounces
Yellow wax	1 ounce
Venetian red	1 ounce

Melt the wax and rosin on a water bath and add, under constant stirring, the Venetian red previously well dried. Stir until nearly cool, so as to prevent the Venetian red from settling to the bottom.

II.—Portland cement	2 ounces
Prepared chalk	1 ounce
Fine sand	1 ounce
Solution of sodium silicate enough to form a semi-liquid paste.	
III.—Litharge	2 parts
White lead	1 part

Work into a pasty condition by using 3 parts boiled linseed oil, 1 part copal varnish.

Celluloid Cements.—I.—To mend broken draughting triangles and other celluloid articles, use 3 parts alcohol and 4 parts ether mixed together and applied to the fracture with a brush until the edges become warm. The edges are then stuck together, and left to dry for at least 24 hours.

II.—Camphor, 1 part; alcohol, 4 parts. Dissolve and add equal quantity (by weight) of shellac to this solution.

III.—If firmness is desired in putting celluloid on wood, tin, etc., the following gluing agent is recommended, viz.: A compound of 2 parts shellac, 3 parts spirit of camphor, and 4 parts strong alcohol.

IV.—Shellac.. ..... 2 ounces
Spirits of camphor.. 2 ounces
Alcohol, 90 per cent.. 6 to 8 ounces

V.—Make a moderately strong glue or solution of gelatin. In a dark place or a dark room mix with the above a small amount of concentrated solution of potassium dichromate. Coat the back of the label, which must be clean, with a thin layer of the mixture. Strongly press the label against the bottle and keep the two in close contact by tying with twine or otherwise. Expose to sunlight for some hours; this causes the cement to be insoluble even in hot water.

VI.—Lime..... av. oz. 1
White of egg..... av. oz. 2½
Plaster of Paris.... av. oz. 5½
Water..... fl. oz. 1

Reduce the lime to a fine powder; mix it with the white of egg by trituration, forming a uniform paste. Dilute with water, rapidly incorporate the plaster of Paris, and use the cement immediately. The surfaces to be cemented must first be moistened with water so that the cement will readily adhere. The pieces must be firmly pressed together and kept in this position for about 12 hours.

Cementing Celluloid and Hard-Rubber Articles.—I.—Celluloid articles can be mended by making a mixture composed of 3 parts of alcohol and 4 parts of ether. This mixture should be kept in a well-corked bottle, and when celluloid articles are to be mended, the broken surfaces are painted over with the alcohol and ether mixture until the surfaces soften: then press together and bind and allow to dry for at least 24 hours.

II.—Dissolve 1 part of gum camphor in 4 parts of alcohol; dissolve an equal weight of shellac in such strong camphor solution. The cement is applied warm and the parts united must not be disturbed until the cement is hard. Hard-rubber articles are never mended to form a strong joint.

III.—Melt together equal parts of gutta percha and real asphaltum. The cement is applied hot, and the broken surfaces pressed together and held in place while cooling.

Sign-Letter Cements.—

I.—Copal varnish..... 15 parts
Drying oil ..... 5 parts
Turpentine (spirits). 3 parts
Oil of turpentine.... 2 parts
Liquefied glue..... 5 parts

Melt all together on a water bath until well mixed, and then add 10 parts slaked lime.

II.—Mix 100 parts finely powdered white litharge with 50 parts dry white lead, knead together 3 parts linseed oil varnish and 1 part copal varnish into a firm dough. Coat the side to be attached with this, removing the superfluous cement. It will dry quickly and become very hard.

III.—Copal varnish..... 15 parts
Linseed-oil varnish . 5 parts
Raw turpentine..... 3 parts
Oil of turpentine.... 2 parts
Carpenters' glue, dissolved in water... 5 parts
Precipitated chalk.. 10 parts

IV.—Mastic gum..... 1 part
Litharge, lead..... 2 parts
White lead..... 1 part
Linseed oil..... 3 parts

Melt together to a homogeneous mass. Apply hot. To make a thorough and reliable job, the letters should be heated to at least the temperature of the cement.

To Fix Gold Letters, etc., upon Glass.—I.—The glass must be entirely clean and polished, and the medium is prepared in the following manner: One ounce fish glue or isinglass is dissolved in water so that the latter covers the glue. When this is dissolved a quart of rectified spirit of wine is added, and enough water is poured in to make up one-quarter the whole. The substance must be kept well corked.

II.—Take ½ quart of the best rum and ¼ ounce fish glue, which is dissolved in the former at a moderate degree of heat. Then add ½ quart distilled water, and filter through a piece of old linen. The glass is laid upon a perfectly level table and is covered with this substance to the thickness of ⅛ inch, using a clean brush. Seize the gold leaf with a pointed object and place it smoothly upon the prepared mass, and it will be attracted by the glass at once. After 5 minutes hold the glass slightly slanting so that the superfluous mass can run off, and leave the plate in this position for 24 hours, when it will be perfectly dry. Now trace the letters or the design on a piece of paper, and perforate the lines with a thick needle, making the holes $\frac{1}{16}$ inch apart. Then place the perforated paper upon the surface of the glass, and stamp the tracery on with powdered chalk. The paper pattern is then carefully removed, and the accurate design will remain upon the gold. The outlines are now filled out with an oily gold mass, mixed with a little chrome orange and diluted with boiled oil or turpentine. When all is dry the superfluous gold is washed off

with water by means of a common rag. The back of the glass is then painted with a suitable color.

Attaching Enamel Letters to Glass.—To affix enamel letters to glass, first clean the surface of the glass perfectly, leaving no grease or sticky substance of any kind adhering to the surface. Then with a piece of soap sketch the outlines of the design. Make the proper division of the guide lines, and strike off accurately the position each letter is to occupy. Then to the back of the letters apply a cement made as follows: White lead ground in oil, 2 parts; dry white lead, 3 parts. Mix to a soft putty consistency with good copal varnish.

With a small knife or spatula apply the cement to the back of the letters, observing especial care in getting the mixture well and uniformly laid around the inside edges of the letter. In attaching the letters to the glass make sure to expel the air from beneath the characters, and to do this, work them up and down and sidewise. If the weather be at all warm, support the letters while drying by pressing tiny beads of sealing wax against the glass, close to the under side or bottom of the letters. With a putty knife, keenly sharpened on one edge, next remove all the surplus cement. Give the letters a hard, firm pressure against the glass around all edges to securely guard against the disruptive attacks of moisture.

The seepage of moisture beneath the surface of the letters is the main cause of their early detachment from the glass.

The removal of the letters from the glass may be effected by applying turpentine to the top of the characters, allowing it to soak down and through the cement. Oxalic acid applied in the same way will usually slick the letters off in a trice.

Cement for Porcelain Letters.—Slake 15 parts of fresh quicklime in 20 parts of water. Melt 50 parts of caoutchouc and 50 parts of linseed-oil varnish together, and bring the mixture to a boil. While boiling, pour the liquid on the slaked lime, little by little, under constant stirring. Pass the mixture, while still hot, through muslin, to remove any possible lumps, and let cool. It takes the cement 2 days to set completely, but when dry it makes a joint that will resist a great deal of strain. By thinning the mixture down with oil of turpentine, a brilliant, powerfully adhesive varnish is obtained.

Water-Glass Cements. — I. — Water glass (sodium of potassium silicate), which is frequently recommended for cementing glass, does not, as is often asserted, form a vitreous connection between the joined surfaces; and, in fact, some of the commercial varieties will not even dry, but merely form a thick paste, which has a strong affinity for moisture. Good 30° B. water glass is, however, suitable for mending articles that are exposed to heat, and is best applied to surfaces that have been gently warmed; when the pieces are put together they should be pressed warmly, to expel any superfluous cement, and then heated strongly.

To repair cracked glasses or bottles through which water will leak, water glasses may be used, the application being effected in the following easy manner: The vessel is warmed to induce rarefaction of the internal air, after which the mouth is closed, either by a cork in the case of bottles, or by a piece of parchment or bladder if a wide-mouthed vessel is under treatment.

While still hot, the outside of the crack is covered with a little glass, and the vessel set aside to cool, whereupon the difference between the pressure of the external and internal air will force the cement into the fissure and close it completely. All that is then necessary is to take off the cover and leave the vessel to warm for a few hours. Subsequently rinse it out with lime water, followed by clean water, and it will then hold any liquid, acids and alkaline fluids alone excepted.

II.—When water glass is brought into contact with calcium chloride, a calcium silicate is at once formed which is insoluble in water. It seems possible that this reaction may be used in binding together masses of sand, etc. The process indicated has long been used in the preservation of stone which has become "weathered." The stone is first brushed with the water glass and afterwards with a solution of calcium chloride. The conditions here are of course different.

Calcium chloride must not be confounded with the so-called "chloride of lime" which is a mixture of calcium hypochlorite and other bodies.

To Fasten Paper Tickets to Glass —To attach paper tickets to glass, the employment of water glass is efficacious. Care should be taken to spread this product on the glass and not on the paper, and then to apply the paper dry, which should be done immediately. When the solution is dry the paper cannot be de-

tached. The silicate should be somewhat diluted. It is spread on the glass with a rag or a small sponge.

JEWELERS' CEMENTS.

Jewelers and goldsmiths require, for the cementing of genuine and colored gems, as well as for the placing of colored folio under certain stones, very adhesive gluing agents, which must, however, be colorless. In this respect these are distinguished chiefly by the so-called diamond cement and the regular jewelers' cement. Diamond cement is much esteemed by jewelers for cementing precious stones and corals, but may also be employed with advantage for laying colored fluxes of glass on white glass. The diamond cement is of such a nature as to be able to remain for some time in contact with water without becoming soft. It adheres best between glass or between precious stones. It is composed as follows: Isinglass 8 parts, gum ammoniac 1 part, galbanum 1 part, spirit of wine 4 parts. Soak the isinglass in water with admixture of a little spirit of wine and add the solution of the gums in the remainder of the spirit of wine. Before use, heat the diamond cement a little so as to soften it. Jewelers' cement is used for similar purposes as is the diamond cement, and is prepared from: Isinglass (dry) 10 parts, mastic varnish 5 parts. Dissolve the isinglass in very little water, adding some strong spirit of wine. The mastic varnish is prepared by pouring a mixture of highly rectified spirit of wine and benzine over finely powdered mastic and dissolving it in the smallest possible quantity of liquid. The two solutions of isinglass and mastic are intimately ground together in a porcelain dish.

Armenian Cement.—The celebrated "Armenian" cement, so called formerly used by Turkish and Oriental jewelers generally, for setting precious stones, "facing diamonds," rubies, etc., is made as follows:

Mastic gum.....	10 parts
Isinglass (fish glue) .	20 parts
Gum ammoniac....	5 parts
Alcohol absolute....	60 parts
Alcohol, 50 per cent..	35 parts
Water.....	100 parts

Dissolve the mastic in the absolute alcohol; dissolve, by the aid of gentle heat, on the water bath, the isinglass in the water, and add 10 parts of the dilute alcohol. Now dissolve the ammoniacum in the residue of the dilute alcohol. Add the first solution to the second, mix thoroughly by agitation and then add the solution of gum ammoniac and stir well in. Finally put on the water bath, and keeping at a moderate heat, evaporate the whole down to 175 parts.

Cement for Enameled Dials.—The following is a good cement for enameled dials, plates, or other pieces: Grind into a fine powder 2½ parts of dammar rosin and 2½ parts of copal, using colorless pieces if possible. Next add 2 parts of Venetian turpentine and enough spirit of wine so that the whole forms a thick paste. To this grind 3 parts of the finest zinc white. The mass now has the consistency of prepared oil paint. To remove the yellow tinge of the cement add a trifle of Berlin blue to the zinc white. Finally, the whole is heated until the spirit of wine is driven off and a molten mass remains, which is allowed to cool and is kept for use. Heat the parts to be cemented.

Watch-Lid Cement.—The hardest cement for fixing on watch lids is shellac. If the lids are exceedingly thin the engraving will always press through. Before cementing it on the inside of the lid, in order not to injure the polish, it is coated with chalk dissolved in alcohol, which is first allowed to dry. Next melt the shellac on the stick, heat the watch lid and put it on. After the engraving has been done, simply force the lid off and remove the remaining shellac from the latter by light tapping. If this does not remove it completely lay the lid in alcohol, leaving it therein until all the shellac has dissolved. All that remains to be done now is to wash out the watch lid.

Jewelers' Glue Cement.—Dissolve on a water bath 50 parts of fish glue in a little 95-per-cent alcohol, adding 4 parts, by weight, of gum ammoniac. On the other hand, dissolve 2 parts, by weight, of mastic in 10 parts, by weight, of alcohol. Mix these two solutions and preserve in a well-corked flask. For use it suffices to soften it on the water bath.

Casein Cements.—

I.—Borax.....	5 parts
Water.....	95 parts
Casein, sufficient quantity.	

Dissolve the borax in water and incorporate enough casein to produce a mass of the proper consistency.

II.—The casein is made feebly alkaline by means of soda or potash lye and

then subjected for about 24 hours to a temperature of 140° F. Next follow the customary admixture, such as lime and water glass, and finally, to accomplish a quicker resinification, substances containing tannin are added. For tannic admixtures to the partially disintegrated casein, slight quantities—about 1 per cent—of gallic acid, cutch, or quercitannic acid are employed. The feebly alkaline casein cement containing tannic acid is used in the well-known manner for the gluing together of wood.

For Metals.—Make a paste with 16 ounces casein, 20 ounces slaked lime, and 20 ounces of sand, in water.

For Glass.—I.—Dissolve casein in a concentrated solution of borax.

II.—Make a paste of casein and water glass.

Pasteboard and Paper Cement.—I.—Let pure glue swell in cold water; pour and press off the excess; put on the water bath and melt. Paper or other material cemented with this is then immediately, before the cement dries, submitted to the action of formaldehyde and dried. The cement resists the action of water, even hot.

II.—Melt together equal parts of good pitch and gutta percha. To 9 parts of this mass add 3 parts of boiled linseed oil and ⅓ part litharge. The heat is kept up until, with constant stirring, an intimate union of all the ingredients has taken place. The mixture is diluted with a little benzine or oil of turpentine and applied while still warm. The cement is waterproof.

III.—The *National Druggist* says that experience with pasting or cementing parchment paper seems to show that about the best agent is casein cement, made by dissolving casein in a saturated aqueous solution of borax.

IV.—The following is recommended for paper boxes:

Chloral hydrate.....	5 parts
Gelatin, white.....	8 parts
Gum arabic.....	2 parts
Boiling water.....	30 parts

Mix the chloral, gelatin, and gum arabic in a porcelain container, pour the boiling water over the mixture and let stand for 1 day, giving it a vigorous stirring several times during the day. In cold weather this is apt to get hard and stiff, but this may be obviated by standing the container in warm water for a few minutes. This paste adheres to any surface whatever.

Waterproof Cements for Glass, Stoneware, and Metal.—I.—Make a paste of sulphur, sal ammoniac, iron filings, and boiled oil.

II.—Mix together dry: Whiting, 6 pounds; plaster of Paris, 3 pounds; sand, 3 pounds; litharge, 3 pounds; rosin, 1 pound. Make to a paste with copal varnish.

III.—Make a paste of boiled oil, 6 pounds; copal, 6 pounds; litharge, 2 pounds; white lead, 1 pound.

IV.—Make a paste with boiled oil, 3 pounds; brickdust 2 pounds; dry slaked lime, 1 pound.

V.—Dissolve 93 ounces of alum and 93 ounces of sugar of lead in water to concentration. Dissolve separately 152 ounces of gum arabic in 25 gallons of water, and then stir in 62½ pounds of flour. Then heat to a uniform paste with the metallic salts, but take care not to boil the mass.

VI.—For Iron and Marble to Stand in Heat.—In 3 pounds of water dissolve first, 1 pound water glass and then 1 pound of borax. With the solution make 2 pounds of clay and 1 pound of barytes, first mixed dry, to a paste.

VII.—Glue to Resist Boiling Water.—Dissolve separately in water 55 pounds of glue and a mixture of 40 pounds of bichromate and 5 pounds of alum. Mix as wanted.

VIII. (Chinese Glue).—Dissolve shellac in 10 times its weight of ammonia.

IX.—Make a paste of 40 ounces of dry slaked lime 10 ounces of alum, and 50 ounces of white of egg.

X.—Alcohol	1,000 parts
Sandarac.....	60 parts
Mastic.....	60 parts
Turpentine oil....	60 parts

Dissolve the gums in the alcohol and add the oil and stir in. Now prepare a solution of equal parts of glue and isinglass, by soaking 125 parts of each in cold water until it becomes saturated, pouring and pressing off the residue, and melting on the water bath. This should produce a volume of glue nearly equal to that of the solution of gums. The latter should, in the meantime, have been cautiously raised to the boiling point on the water bath, and then mixed with the hot glue solution.

It is said that articles united with this substance will stand the strain of cold water for an unlimited time, and it takes hot water even a long time to affect it.

XI.—Burgundy pitch..... 6 parts
Gutta percha..... 1 part
Pumice stone, in fine powder..... 3 parts

Melt the gutta percha very carefully, add the pumice stone, and lastly the pitch, and stir until homogeneous.

Use while still hot. This cement will withstand water and dilute mineral acids.

LEATHER AND RUBBER CEMENTS.

I.—Use a melted mixture of gutta percha and genuine asphalt, applied hot. The hard-rubber goods must be kept pressed together until the cement has cooled.

II.—A cement which is effective for cementing rubber to iron and which is especially valuable for fastening rubber bands to bandsaw wheels is made as follows: Powdered shellac, 1 part; strong water of ammonia, 10 parts. Put the shellac in the ammonia water and set it away in a tightly closed jar for 3 or 4 weeks. By that time the mixture will become a perfectly liquid transparent mass and is then ready for use. When applied to rubber the ammonia softens it, but it quickly evaporates, leaving the rubber in the same condition as before. The shellac clings to the iron and thus forms a firm bond between the iron and the rubber.

III.—Gutta percha, white. 1 drachm
Carbon disulphide.. 1 ounce

Dissolve, filter, and add:

India rubber..... 15 grains

Dissolve.

Cement for Metal on Hard Rubber.—I.—Soak good Cologne glue and boil down so as to give it the consistency of joiners' glue, and add, with constant stirring, enough sifted wood ashes until a homogeneous, moderately thick mass results. Use warm and fit the pieces well together while drying.

How to Unite Rubber and Leather.—II.—Roughen both surfaces, the leather and the rubber, with a sharp glass edge; apply to both a diluted solution of gutta percha in carbon bisulphide, and let this solution soak into the material. Then press upon each surface a skin of gutta percha $\frac{1}{10}$ of an inch in thickness between rolls. The two surfaces are now united in a press, which should be warm but not hot. This method should answer in all cases in which it is applicable. The other prescription covers cases in which a press cannot be used. Cut 30 parts of rubber into small pieces, and dissolve it in 140 parts of carbon bisulphide, the vessel being placed on a water bath of 30° C. (86° F.). Further, melt 10 parts of rubber with 15 of colophony, and add 35 parts of oil of turpentine. When the rubber has been completely dissolved, the two liquids may be mixed. The resulting cement must be kept well corked.

To Fasten Rubber to Wood.—I.—Make a cement by macerating virgin gum rubber, or as pure rubber as can be had, cut in small pieces, in just enough naphtha or gasoline to cover it. Let it stand in a very tightly corked or sealed jar for 14 days, or a sufficient time to become dissolved, shaking the mixture daily.

II.—Dissolve pulverized gum shellac, 1 ounce, in 9½ ounces of strong ammonia. This of course must be kept tightly corked. It will not be as elastic as the first preparation.

III.—Fuse together shellac and gutta percha in equal weights.

IV.—India rubber..... 8 ounces
Gutta percha..... 4 ounces
Isinglass..... 2 ounces
Bisulphide of carbon 32 ounces

V.—India rubber..... 5 ounces
Gum mastic..... 1 ounce
Chloroform..... 3 ounces

VI.—Gutta percha..... 16 ounces
India rubber..... 4 ounces
Pitch..... 4 ounces
Shellac..... 1 ounce
Linseed oil..... 1 ounce

Amalgamate by heat.

VII.—Mix 1 ounce of oil of turpentine with 10 ounces of bisulphide of carbon in which as much gutta percha as possible has been dissolved.

VIII.—Amalgamate by heat:

Gutta percha..... 100 ounces
Venice turpentine. 80 ounces
Shellac..... 8 ounces
India rubber..... 2 ounces
Liquid storax..... 10 ounces

IX.—Amalgamate by heat:

India rubber..... 100 ounces
Rosin..... 15 ounces
Shellac..... 10 ounces

Then dissolve in bisulphide of carbon.

X.—Make the following solutions separately and mix:

(*a*) India rubber..... 5 ounces
Chloroform..... 140 ounces

(*b*) India rubber..... 5 ounces
Rosin..... 2 ounces
Venice turpentine. 1 ounce
Oil of turpentine.. 20 ounces

Cement for Patching Rubber Boots and Shoes.—

I.—India rubber, finely chopped	100 parts
Rosin	15 parts
Shellac	10 parts
Carbon disulphide, q. s. to dissolve.	

This will not only unite leather to leather, india rubber, etc., but will unite rubber to almost any substance.

II.—Caoutchouc, finely cut	4 parts
India rubber, finely cut	1 part
Carbon disulphide	32 parts

Dissolve the caoutchouc in the carbon disulphide, add the rubber, let macerate a few days, then mash with a palette knife to a smooth paste. The vessel in which the solution is made in both instances above must be kept tightly closed, and should have frequent agitations.

III.—Take 100 parts of crude rubber or caoutchouc, cut it up in small bits, and dissolve it in sufficient carbon bisulphide, add to it 15 parts of rosin and 10 parts of gum lac. The user must not overlook the great inflammability and exceedingly volatile nature of the carbon bisulphide.

Tire Cements.—

I.—India rubber	15 grams
Chloroform	2 ounces
Mastic	½ ounce

Mix the india rubber and chloroform together, and when dissolved, the mastic is added in powder. It is then allowed to stand a week or two before using.

II.—The following is recommended as very good for cementing pneumatic tires to bicycle wheels:

Shellac	1 ounce
Gutta percha	1 ounce
Sulphur	45 grains
Red lead	45 grains

Melt together the shellac and gutta percha, then add, with constant stirring, the sulphur and red lead. Use while hot.

III.—Raw gutta percha	16 ounces
Carbon bisulphide	72 ounces
Eau de Cologne	2⅔ ounces

This cement is the subject of an English patent and is recommended for patching cycle and motor tires, insulating electric wires, etc.

IV.—A good thick shellac varnish with which a small amount of castor oil has been mixed will be found a very excellent bicycle rim cement. The formula recommended by Edel is as follows:

Shellac	1 pound
Alcohol	1 pint

Mix and dissolve, then add:

Castor oil	½ ounce

The castor oil prevents the cement from becoming hard and brittle.

A cement used to fasten bicycle tires may be made by melting together at a gentle heat equal parts of gutta percha and asphalt. Apply hot. Sometimes a small quantity each of sulphur and red lead is added (about 1 part of each to 20 parts of cement).

Cements for Leather.—

I.—Gutta percha	20 parts
Syrian asphalt, powdered	20 parts
Carbon disulphide	50 parts
Oil of turpentine	10 parts

The gutta percha, shredded fine, is dissolved in the carbon disulphide and turpentine oil. To the solution add the asphalt and set away for several days, or until the asphalt is dissolved. The cement should have the consistency of honey. If the preparation is thinner than this let it stand, open, for a few days. Articles to be patched should first be washed with benzine.

II.—Glue	1 ounce
Starch paste	2 ounces
Turpentine	1 drachm
Water, a sufficient quantity.	

Dissolve the glue in sufficient water with heat; mix the starch paste with water; add the turpentine, and finally mix with the glue while hot.

III.—Soak for one day 1 pound of common glue in enough water to cover, and 1 pound of isinglass in ale droppings. Then mix together and heat gently until boiling. At this point add a little pure tannin and keep boiling for an hour. If the glue and isinglass when mixed are too thick, add water. This cement should be used warm and the jointed leather pressed tightly together for 12 hours.

IV.—A waterproof cement for leather caoutchouc, or balata, is prepared by dissolving gutta percha, caoutchouc, benzoin, gum lac, mastic, etc., in some convenient solvent like carbon disulphide, chloroform, ether, or alcohol. The best solvent, however, in the case of gutta percha, is carbon disulphide, and ether for mastic. The most favorable proportions are as follows: Gutta percha, 200 to 300 parts to 100 parts of the solvent, and 75 to 85 parts of mastic to 100 parts of ether. From 5 to 8 parts of the former solution are mixed with 1

part of the latter, and the mixture is then boiled on the water bath, or in a vessel fitted with a water jacket.

V.—Make a solution of 200 to 300 parts of caoutchouc, gutta percha, india rubber, benzoin, or similar gum, in 1,000 parts of carbon disulphide, chloroform, ether, or alcohol, and of this add 5 to 8 parts to a solution of mastic (75 to 125 parts) in ether 100 parts, of equal volume and boil together. Use hot water as the boiling agent, or boil very cautiously on the water bath.

VI.—Forty parts of aluminum acetate, 10° B., 10 parts of glue, 10 parts of rye flour. These materials are either to be simultaneously mixed and boiled, or else the glue is to be dissolved in the aluminum acetate, and the flour stirred into the solution. This is an excellent cement for leather, and is used in so-called art work with leather, and with leather articles which are made of several pieces. It is to be applied warm.

Rubber Cement for Cloth.—The following formulas have been recommended:

I.—Caoutchouc, 5 parts; chloroform, 3 parts. Dissolve and add gum mastic (powder) 1 part.

II.—Gutta percha, 16 parts; india rubber, 4 parts; pitch, 2 parts; shellac, 1 part; linseed oil, 2 parts. Reduce the solids to small pieces, melt together with the oil and mix well.

III.—The following cement for mending rubber shoes and tires will answer similar purposes:

Caoutchouc in shavings	10	Parts by weight.
Rosin	4	
Gum turpentine	40	
Oil turpentine, enough.		

Melt together first the caoutchouc and rosin, then add the gum turpentine, and when all is liquefied, add enough of oil of turpentine to preserve it liquid. A second solution is prepared by dissolving together:

Caoutchouc	10	Parts by weight.
Chloroform	280	

For use these two solutions are mixed. Wash the hole in the rubber shoe over with the cement, then a piece of linen dipped in it is placed over it; as soon as the linen adheres to the sole, the cement is then applied as thickly as required.

CEMENTS FOR METALS AND FOR ATTACHING VARIOUS SUBSTANCES TO METALS:

Cements for Iron.—I.—To make a good cement for iron on iron, make a thick paste, with water, of powdered iron, 60 parts; sal ammoniac, 2 parts, and sulphur flowers, 1 part. Use while fresh.

II.—Sulphur flowers, 6 parts; dry white lead 6 parts, and powdered borax, 1 part. Mix by sifting and keep as a dry powder in a closed tin box. To use, make into a thin paste with strong sulphuric acid and press together immediately. This cement will harden in 5 days.

III.—Graphite	50 pounds
Whiting	15 pounds
Litharge	15 pounds

Make to a paste with a boiled oil.

IV.—Make a paste of white lead and asbestos.

V.—Make a paste of litharge and glycerine. Red lead may be added. This also does for stone.

VI.—Make a paste of boiled oil of equal parts of white lead, pipe clay, and black oxide of manganese.

VII.—Make iron filings to a paste with water glass.

VIII.—Sal ammoniac	4 ounces
Sulphur	2 ounces
Iron filings	32 ounces

Make as much as is to be used at once to a paste with a little water. This remark applies to both the following dry recipes:

IX.—Iron filings	160 ounces
Lime	80 ounces
Red lead	16 ounces
Alum	8 ounces
Sal ammoniac	2 ounces
X.—Clay	10 ounces
Iron filings	4 ounces
Salt	1 ounce
Borax	1 ounce
Black oxide of manganese	2 ounces
XI.—Mix:	
Iron filings	180 ounces
Lime	45 ounces
Salt	8 ounces
XII.—Mix:	
Iron filings	140 ounces
Hydraulic lime	20 ounces
Sand	25 ounces
Sal ammoniac	3 ounces

Either of these last two mixtures is made into a paste with strong vinegar just before use.

XIII.—Mix equal weights of zinc oxide and black oxide of manganese into a paste with water glass.

XIV.—Copal varnish, 15 parts; hydrated lime, 10 parts; glue *de nerfs* (of sinews), 5 parts; fat drying oil, 5 parts;

powdered turpentine, 3 parts; essence of turpentine, 2 parts. Dissolve the glue *de nerfs* on the water bath, add all the other substances, and triturate intimately.

XV.—Copal varnish, 15 parts; powdered turpentine, 3 parts; essence of turpentine, 2 parts; powdered fish glue, 3 parts; iron filings, 3 parts; ocher, 10 parts.

XVI.—To make a cement for cast iron, take 16 ounces cast-iron borings; 2 ounces sal ammoniac, and 1 ounce sulphur. Mix well and keep dry. When ready to use take 1 part of this powder to 20 parts of cast-iron borings and mix thoroughly into a stiff paste, adding a little water.

XVII.—

Litharge	2 parts
Boiled linseed oil	2 parts
White lead	1 part
Copal	1 part

Heat together until of a uniform consistence and apply warm.

XVIII.—A cement for iron which is said to be perfectly waterproof and fireproof is made by working up a mixture of equal weights of red lead and litharge with glycerine till the mass is perfectly homogeneous and has the consistency of a glazier's putty. This cement is said to answer well, even for very large iron vessels, and to be unsurpassable for stopping up cracks in large iron pans of steam pipes.

Cement for Metal, Glass, and Porcelain.—A soft alloy is prepared by mixing from 30 to 36 parts of copper precipitated in the form of a fine brown powder, with sulphuric acid of a specific gravity of 1.85 in a cast-iron or porcelain mortar and incorporating by stirring with 75 parts of mercury, the acid being afterwards removed by washing with water. In from 10 to 14 hours the amalgam becomes harder than tin, but when heated to 692° F., it can be kneaded like wax. In this condition it is applied to the surface to be cemented, and will fix them firmly together on cooling.

Dissolve 1 drachm of gum mastic in 3 drachms of spirits of wine. In a separate vessel containing water soak 3 drachms of isinglass. When thoroughly soaked take it out of the water and put it into 5 drachms of spirits of wine. Take a piece of gum ammoniacum the size of a large pea and grind it up finely with a little spirits of wine and isinglass until it has dissolved. Then mix the whole together with sufficient heat. It will be found most convenient to place the vessel on a hot-water bath. Keep this cement in a bottle closely stoppered, and when it is to be used, place it in hot water until dissolved.

Cements for Fastening Porcelain to Metal.—I.—Mix equal parts of alcohol (95 per cent) and water, and make a paste by incorporating the liquid with 300 parts of finely pulverized chalk and 250 parts of starch.

II.—Mix finely powdered burned lime, 300 parts, with powdered starch, 250 parts, and moisten the mixture with a compound of equal parts of water and alcohol of 95 per cent until a paste results.

III.—Cement or plaster can be used if the surfaces are sufficiently large; cement is the better article when the object may be exposed to moisture or subjected to much pressure. A process which can be recommended consists in mingling equal weights of chalk, brickdust, clay, and Romain cement. These materials, pulverized and sifted, are incorporated with linseed oil in the proportion of half a kilo of oil to 3 kilos of the mingled powder. The Romain or Romanic cement is so designated from the district in France where the calcareous stone from which it is prepared is found in considerable quantity. Although its adhesive qualities are unquestioned, there are undoubtedly American cements equally as good.

IV.—Acetate of lead, 46½ parts by weight; alum, 46½ parts by weight; gum arabic, 76 parts by weight; flour, 500 parts by weight; water, 2,000 parts by weight. Dissolve the acetate of lead and the alum in a little water; on the other hand dissolve the gum arabic in water by pouring, for instance, the 2 liters of boiling water on the gum arabic reduced to powder. When the gum has dissolved, add the flower, put all on the fire, and stir well with a piece of wood; then add the solution of acetate of lead and the alum; agitate well so as to prevent any lumps from forming; retire from the fire before allowing to boil. This glue is used cold, does not peel off, and is excellent to make wood, glass, cardboard, etc. adhere to metals.

Cement for Leather and Iron.—To face a cast-iron pulley with leather apply acetic acid to the face of the pulley with a brush, which will roughen it by rusting, and then when dry apply a cement made of 1 pound of fish glue and ½ pound of common glue, melted in a mixture of alcohol and water. The leather should then be placed on the pulley and dried under pressure.

Amber Cements.—I.—To solder together two pieces of yellow amber, slightly heat the parts to be united and moisten them with a solution of caustic soda; then bring the two pieces together quickly.

II.—Dissolve in a closed bottle 75 parts of cut-up caoutchouc in 60 parts of chloroform. Add 15 parts of mastic and let the mixture stand in the cold until all has dissolved.

III.—Moisten the pieces to be joined with caustic potash and press them together when warm. The union is so perfect that no trace of the juncture is visible. A concentrated alcoholic solution of the rosin over the amber, soluble in alcohol, is also employed for this purpose. Another medium is a solution of hard and very finely powdered copal in pure sulphuric ether. Coat both fractures, previously well cleaned, with this solution and endeavor to combine them intimately by tying or pressing.

IV.—In 30 parts by weight of copal dissolve 30 parts by weight of alumina by means of a water bath. Bathe the surface to be cemented with this gelatinous liquid, but very slightly. Unite the fractures and press them together firmly until the mixture is dry.

Acid-Proof Cements for Stoneware and Glass.—I.—Mix with the aid of heat equal weights of pitch, rosin, and plaster of Paris.

II.—Mix silicate of soda to a paste with ground glass.

III.—Mix boiled oil to a paste with china clay.

IV.—Mix coal tar to a paste with pipe clay.

V.—Mix boiled oil to a paste with quicklime.

VI.—Mix with the aid of heat: Sulphur, 100 pounds; tallow, 2 pounds; rosin, 2 pounds. Thicken with ground glass.

VII.—Mix with the aid of heat: Rosin, 2 pounds; sulphur, 2 pounds; brickdust, 4 pounds.

VIII.—Mix with the aid of heat 2 pounds of india rubber and 4 pounds of boiled oil. Thicken with 12 pounds of pipe clay.

IX.—Fuse 100 pounds of india rubber with 7 pounds of tallow. Then make to a paste with dry slaked lime and finally add 20 pounds of red lead.

X.—Mix with the aid of heat: Rosin, 24 pounds; red ocher, 8 pounds; boiled oil, 2 pounds; plaster of Paris, 4 pounds.

Acid-Proof Cement for Wood, Metals, etc.—

I.—Powdered asbestos... 2 parts
Ground baryta..... 1 part
Sodium water-glass solution..... 2 parts
Mix.

II.—To withstand hot nitric acid the following is used:

Sodium water-glass solution..... 2 parts
Sand..... 1 part
Asbestos..... 1 part
Mix.

III.—Asbestos..... 2 parts
Sulphate of barium... 3 parts
Silicate of sodium.... 2 parts

By mixing these ingredients a cement strong enough to resist the strongest nitric acid will be obtained.

IV.—If hot acids are dealt with, the following mixture will be found to possess still more resistant powers:

Silicate of sodium (50° Baumé)..... 2 parts
Fine sand..... 1 part
Asbestos..... 1 part

Both these cements take a few hours to set. If the cement is wanted to set at once, use silicate of potassium, instead of silicate of sodium. This mixture will be instantly effective and possesses the same power of resistance as the other.

Directions for Repairing Broken Glass, Porcelain, Bric-à-Brac.—Broken glass, china, bric-à-brac, and picture frames, not to name casts, require each a different cement—in fact, several different cements. Glass may be beautifully mended to look at, but seldom so as to be safely used. For clear glass the best cement is isinglass dissolved in gin. Put 2 ounces of isinglass in a clean, wide-mouthed bottle, add half a pint of gin, and set in the sun until dissolved. Shake well every day, and before using strain through double lawn, squeezing very gently.

Spread a white cloth over the mending table and supply it with plenty of clean linen rags, strong rubber bands, and narrow white tape, also a basin of tepid water and a clean soft towel. Wash the broken glass very clean, especially along the break, but take care not to chip it further. Wet both broken edges well with the glue, using a camel's-hair pencil. Fit the break to a nicety, then slip on rubber bands length- and cross-wise, every way they will hold. If they will not hold true as upon a stemmed

thing, a vase or jug or scent bottle, string half a dozen bands of the same size and strength upon a bit of tape, and tie the tape about neck or base before beginning the gluing. After the parts are joined slip another tape through the same bands and tie it above the fracture; thus with all their strength the bands pull the break together. The bands can be used thus on casts of china—in fact, to hold anything mendable. In glass mending the greater the pressure the better—if only it stops short of the breaking point. Properly made the isinglass cement is as clear as water. When the pieces fit true one on the other the break should be hardly visible, if the pressure has been great enough to force out the tiny bubbles, which otherwise refract the light and make the line of cleavage distressingly apparent. Mended glass may be used to hold dry things—as rose leaves, sachets, violet powder, even candies and fruits. But it will not bear to have any sort of liquid left standing in it, nor to be washed beyond a quick rinsing in tepid water. In wiping always use a very soft towel, and pat the vessel dry with due regard to its infirmities.

Mend a lamp loose in the collar with sifted plaster of Paris mixed to a very soft paste with beaten white of egg. Have everything ready before wetting up the plaster, and work quickly so it may set in place. With several lamps to mend wet enough plaster for one at a time. It takes less than 5 minutes to set, and is utterly worthless if one tries working it over. Metal work apart from the glass needs the soldering iron. Dust the break well with powdered rosin, tie the parts firmly together, lay the stick of solder above the break, and fetch the iron down on it lightly but firmly. When the solder cools, remove the melted rosin with a cloth dipped in alcohol.

Since breakables have so unhappy a knack of fracturing themselves in such fashion they cannot possibly stand upright, one needs a sand box. It is only a box of handy size with 8 inches of clean, coarse sand in the bottom. Along with it there should be some small leaden weights, with rings cast in them, running from an ounce to a quarter pound. Two of each weight are needed. In use, tapes are tied to the rings, and the pair of weights swung outside the edges of the box, so as to press in place the upper part of a broken thing to which the tapes have been fastened.

Set broken platters on edge in the sand box with the break up. The sand will hold them firm, and the broken bit can be slapped on. It is the same with plates and saucers. None of these commonly requires weighting. But very fine pieces where an invisible seam is wanted should be held firm until partly set, then have the pair of heaviest weights accurately balanced across the broken piece. The weights are also very useful to prop and stay topheavy articles and balance them so they shall not get out of kilter. A cup broken, as is so common with cups, can have the tape passed around it, crossing inside the handle, then be set firmly in the sand, face down, and be held by the hanging weights pulling one against the other.

The most dependable cement for china is pure white lead, ground in linseed oil, so thick it will barely spread smoothly with a knife. Given time enough to harden (some 3 months), it makes a seam practically indestructible. The objection to it is that it always shows in a staring white line. A better cement for fine china is white of egg and plaster. Sift the plaster three times and tie a generous pinch of it loosely in mosquito netting. Then beat the egg until it will stick to the plaster. Have the broken egg very clean, cover both with the beaten egg, dust well with the plaster, fit together at once, tie, using rubber bands if possible, wrap loosely in very soft tissue paper, and bury head and ears in the sand box, taking care that the break lies so that the sand will hold it together. Leave in the box 24 hours. After a week the superfluous plaster may be gently scraped away.

General Formulas for Cements for Repairing Porcelain, Glassware, Crockery, Plaster, and Meerschaum.—I.—An excellent cement for joining broken crockery and similar small articles can be made by melting 4 or 5 parts of rosin (or, better still, gum mastic) with 1 part of beeswax in an iron spoon or similar vessel. Apply while hot. It will not stand great heat.

II.—An excellent cement for porcelain and stoneware is obtained by mixing 20 parts of fish glue with an equal weight of crystallizable acetic acid and evaporate the mixture carefully to a syrupy consistency so that it forms a gelatinous mass on cooling. For use the cement thus obtained is made liquid again by heating and applied to the fracture with a brush. The pieces should now be pressed firmly together, by winding a twine tightly around them, until the cement has hardened.

III.—For luting vessels made of glass,

porcelain, etc., which are to be used to hold strong acids, a mixture of asbestos powder, water glass, and an indifferent powder (permanent white, sand, etc.) is recommended. To begin with, asbestos powder is made into a pulp with three or four times the quantity (weight) of a solution of soda water glass (of 30° B.). The same is exceedingly fat and plastic, but is not very well suited for working, as it shrinks too much and cracks when drying. By an addition of fine writing sand of the same weight as the asbestos used, the mass can be made less fat, so as to obviate shrinking, without detracting from the plasticity. Small vessels were molded from it and dried in the air, to be tested afterwards. Put in water, the hardened mass becomes soft again and falls apart. Brought into contact, however, with very strong mineral acids, it becomes even firmer and withstands the liquid perfectly. Concentrated nitric acid was kept in such small vessels without the mass being visibly attacked or anything penetrating it. The action of the acid manifestly has the effect that silicic acid is set free from the water glass in excess, which closes up the pores entirely and contributes to the lutation. Later on, the mass cannot be dissolved by pure water any more. The mass is also highly fireproof. One of the molded bodies can be kept glowing in a Bunsen gas flame for about half a day after treatment with acid, without slagging in the least. For many purposes it ought to be welcome to have such a mass at hand. It cannot be kept ready for use, however, as it hardens a few hours after being prepared; if potash water glass is used, instead of the soda composition, this induration takes place still more quickly.

IV.—Cement for Glass, Porcelain, etc.

Isinglass (fish glue)	50 parts
Gum ammoniac	4 parts
Gum mastic	2 parts
Alcohol, 95 per cent	10 parts
Water, q. s.	

Soak the isinglass in cold water over night, or until it has become swollen and soft throughout. In the morning throw off any superfluous fluid and throw the isinglass on a clean towel or other coarse cloth, and hang it up in such a way that any free residual water will drain away. Upon doing this thoroughly depends, in a great measure, the strength of the cement. When the gelatin has become thoroughly drained put it into a flask or other container, place it in the water bath and heat carefully until it becomes fluid, being careful not to let it come to a boil, as this injures its adhesive properties (the same may be said in regard to glues and gelatins of all kinds). Dissolve the gums in the alcohol and add the solution to the gelatin after removing the same from the water bath, and letting it cool down to about 160° F. Stir well together or mix by agitation.

The following precautions must be observed: 1. Both surfaces to be joined must be absolutely clean, free from dust, dirt, grease, etc. 2. Where the cement is one that requires the application of heat before use, the objects to be united should also *be heated to a point at least as high as the melting point of the cement.* Otherwise, the cement on application is chilled and consequently fails to make a lasting joint. 3. The thinner the layer of cement the stronger the joint; avoid, therefore, using too much of the binding material. Cover both surfaces to be united, coapt them exactly, and press together as closely as possible. In this manner the thinnest possible layer is secured. 4. Bind the parts securely together, and let remain without loosening or attempting to use the article for 2 or 3 days or longer. A liquid cement acquires its full strength only after evaporation of the fluids used as solvents, and this can occur only from the infinitesimal line of exposed surface.

V.—Liquid Porcelain Cement.—Fish glue, 20 parts; glass acetic acid, 20 parts; heat together until the mass gelatinizes on cooling.

VI.—Take 1 ounce of Russian isinglass, cut in small pieces, and bruise well; then add 6 ounces of warm water, and leave it in a warm place for from 24 to 48 hours. Evaporate the resulting solution to about 3 ounces. Next dissolve ½ ounce of mastic in 4 ounces of alcohol, and add the mastic solution to the isinglass in small quantities at a time, continuing the heat and stirring well. While still hot strain the liquid through muslin.

VII.—For optical glasses, Canada balsam is employed, the two pieces being firmly pressed together. After a while, especially by humidity, punctures will form, and the glass is separated by a mist of varying reflexes, while in certain climates the heat will melt the balsam. For all other glass articles which require only simple treatment, such as knobs of covers, plates, etc., silicate of potash is excellent.

VIII.—Glass Cement.—Dissolve in 150 parts of acetic acid of 96 per cent, 100

parts of gelatin by the use of heat, and add ammonium bichromate, 5 parts. This glue must be kept away from the light.

IX.—White glue.....	10 parts
Potassium bichromate	2 parts
Water.....	100 parts

The glue is dissolved in a portion of the water by the aid of heat, the bichromate in the remainder, and the liquids mixed, the mixing being done in a feebly lighted place, and the mixture is then kept in the dark. It is applied in feeble light, being reliquefied by gentle heat, and the glass, the fractured pieces being tightly clamped together, is then exposed to a strong light for some time. By this exposure the cement becomes insoluble. This is waterproof cement for glass.

X.—Diamond Glass Cement.—Dissolve 100 parts of isinglass in 150 parts of 90 per cent alcohol and add, with constant stirring, 200 parts of powdered rosin. This cement must be preserved in absolutely tight bottles, as it solidifies very quickly.

XI —To unite objects of crystal dissolve 8 parts of caoutchouc and 100 parts of gum mastic in 600 parts of chloroform. Set aside, hermetically closed, for 8 days; then apply with a brush, cold.

XII.—To make a transparent cement for glass, digest together for a week in the cold 1 ounce of india rubber, 67 ounces of chloroform, and 40 ounces of mastic.

XIII.—A mixture of traumaticin, a solution of caoutchouc in chloroform, and a concentrated solution of water glass make a capital cement for uniting articles of glass. Not only is the joint very strong, but it is transparent. Neither changes of temperature nor moisture affect the cement.

XIV.—A transparent cement for porcelain is prepared by dissolving 75 parts of india rubber, cut into small pieces, in a bottle containing 60 parts chloroform; to this add 15 parts green mastic. Let the bottle stand in the cold until the ingredients have become thoroughly dissolved.

XV.—Some preparations resist the action of heat and moisture a short time, but generally yield very quickly. The following cement for glass has proven most resistant to liquids and heat:

Silver litharge	1,000 parts
White lead	50 parts
Boiled linseed oil..	3 parts
Copal varnish	1 part

Mix the lead and litharge thoroughly, and the oil and copal in the same manner and preserve separately. When needed for use, mix in the proportions indicated (150 parts of the powder to 4 parts of the liquid) and knead well together. Apply to the edges of the glass, bind the broken parts together, and let stand for from 24 to 48 hours.

XVI.—To reunite plaster articles dissolve small pieces of celluloid in ether; in a quarter of an hour decant, and use the pasty deposit which remains for smearing the edges of the articles. It dries rapidly and is insoluble in water.

XVII.—To Mend Wedgwood Mortars.—It is easy enough to mend mortars so that they may be used for making emulsions and other light work which does not tax their strength too much. But a mended mortar will hardly be able to stand the force required for powdering hard substances. A good cement for mending mortars is the following:

a.—Glass flour elutriated.	10 parts
Fluorspar, powdered and elutriated.....	20 parts
Silicate of soda	60 parts

Both glass and fluorspar must be in the finest possible condition, which is best done by shaking each in fine powder, with water allowing the coarser particles to deposit, and then to pour off the remainder, which holds the finest particles in suspension. The mixture must be made very rapidly by quick stirring, and when thoroughly mixed must be at once applied. This is said to yield an excellent cement.

b.—Freshly burnt plaster of Paris.....	5 parts
Freshly burnt lime	1 part
White of egg, sufficient.	

Reduce the first two ingredients to a very fine powder and mix them well; moisten the two surfaces to be united with a small quantity of white of egg to make them adhesive; then mix the powder very rapidly with the white of egg and apply the mixture to the broken surfaces. If they are large, two persons should do this, each applying the cement to one portion. The pieces are then firmly pressed together and left undisturbed for several days. The less cement is used the better will the articles hold together.

c.—If there is no objection to dark-colored cement, the very best that can be used is probably marine glue. This is made thus: Ten parts of caoutchouc or india rubber are dissolved in 120 parts of benzine or petroleum naphtha, with

the aid of a gentle heat. When the solution is complete, which sometimes requires from 10 to 14 days, 20 parts of asphalt are melted in an iron vessel and the caoutchouc solution is poured in very slowly in a fine stream and under continued heating, until the mass has become homogeneous and nearly all the solvent has been driven off. It is then poured out and cast into greased tin molds. It forms dark brown or black cakes, which are very hard to break. This cement requires considerable heat to melt it; and to prevent it from being burnt it is best to heat a capsule containing a piece of it first on a water bath until the cake softens and begins to be liquid. It is then carefully wiped dry and heated over a naked flame, under constant stirring, up to about 300° F. The edges of the article to be mended should, if possible, also be heated to at least 212° F., so as to permit the cement to be applied at leisure and with care. The thinner the cement is applied the better it binds.

Meerschaum Cements.—I.—If the material is genuine (natural) meerschaum a lasting joint can be made between the parts by proceeding as follows: Clean a clove or two of garlic (the fresher the better) by removing all the outside hull of skin; throw into a little mortar and mash to a paste. Rub this paste over each surface to be united and join quickly. Bring the parts as closely together as possible and fasten in this position. Have ready some boiling fresh milk; place the article in it and continue the boiling for 30 minutes. Remove and let cool slowly. If properly done, this makes a joint that will stand any ordinary treatment, and is nearly invisible. For composition, use a cement made of quicklime, rubbed to a thick cream with egg albumen.

II.—Mix very fine meerschaum shavings with albumen or dissolve casein in water glass, stir finely powdered magnesia into the mass, and use the cement at once. This hardens quickly.

Asbestos Cement.—Ground asbestos may be made into a cement which will stand a high degree of heat by simply mixing it with a solution of sodium silicate. By subsequent treatment with a solution of calcium chloride the mass may be made insoluble, silicate of calcium being formed.

A cement said to stand a high degree of heat and to be suitable for cementing glass, porcelain, or other vessels intended to hold corrosive acids, is this one:

I.—Asbestos	2 parts
Barium sulphate	3 parts
Sodium silicate	2 parts

By mixing these ingredients a cement strong enough to resist the strongest nitric acid will be obtained. If hot acids are dealt with, the following mixture will be found to possess still more resistant powers:

II.—Sodium silicate	2 parts
Fine sand	1 part
Asbestos powder	1 part

Both these cements take a few hours to set. If the cement is wanted to set at once, use potassium silicate instead of sodium silicate. This mixture will be instantly effective, and possesses the same power of resistance as the other.

Parisian Cement. — Mix 1 part of finely ground glass powder, obtained by levigation, with 3 parts of finely powdered zinc oxide rendered perfectly free from carbonic acid by calcination. Besides prepare a solution of 1 part, by weight, of borax in a very small quantity of hot water and mix this with 50 parts of a highly concentrated zinc chloride solution of 1.5 to 1.6 specific gravity. As is well known the mixture of this powder with the liquid into a soft uniform paste is accomplished only immediately before use. The induration to a stonelike mass takes place within a few minutes, the admixture of borax retarding the solidification somewhat. The pure white color of the powder may be tinted with ocher, manganese, etc., according to the shade desired.

Strong Cement. — Pour over well-washed and cleaned casein 12½ parts of boiled linseed oil and the same amount of castor oil. Boil. Stir actively and add a small amount of a saturated aqueous solution of alum; remove from the fire and set aside. After a while a milky looking fluid will separate and rise. This should be poured off. To the residue add 120 parts of rock candy syrup and 6 parts of dextrin.

A Cheap and Excellent Cement.—A cheap and excellent cement, insoluble after drying in water, petroleum, oils, carbon disulphide, etc., very hard when dry and of very considerable tensile strength, is composed of casein and some tannic-acid compound, as, for instance, calcium tannate, and is prepared as follows:

First, a tannin solution is prepared either by dissolving a tannin salt, or by extraction from vegetable sources (as barks from certain trees, etc.), to which

is added clear lime water (obtained by filtering milk of lime, or by letting the milk stand until the lime subsides) until no further precipitation occurs, and red litmus paper plunged in the fluid is turned blue. The liquid is now separated from its precipitate, either by decantation or otherwise, and the precipitate is dried. In operating with large quantities of the substance, this is done by passing a stream of atmospheric air through the same. The lime tannate obtained thus is then mixed with casein in proportions running from 1 : 1 up to 1 : 10, and the mixture, thoroughly dried, is milled into the consistency of the finest powder. This powder has now only to be mixed with water to be ready for use, the consistency of the preparation depending upon the use to which it is to be put.

Universal Cement.—Take gum arabic, 100 parts, by weight; starch, 75 parts, by weight; white sugar, 21 parts, by weight; camphor, 4 parts, by weight. Dissolve the gum arabic in a little water; also dissolve the starch in a little water. Mix and add the sugar and camphor. Boil on the water bath until a paste formed which, on coating, will thicken.

Cement for Ivory.—Melt together equal parts of gutta percha and ordinary pitch. The pieces to be united have to be warmed.

Cement for Belts.—Mix 50 parts, by weight, of fish glue with equal parts of whey and acetic acid. Then add 50 parts, by weight, of garlic in paste form and boil the whole on the water bath. At the same time make a solution of 100 parts, by weight, of gelatin in the same quantity of whey, and mix both liquids. To the whole add, finally, 50 parts, by weight, of 90-per-cent alcohol and, after filtration, a cement is obtained which can be readily applied with a brush and possesses extraordinary binding qualities.

Cement for Chemical Apparatus.—Melt together 20 parts of gutta percha, 10 parts of yellow wax, and 30 parts of shellac.

Size Over Portland Cement. — The best size to use on Portland cement molding for wall paper would ordinarily be glue and alum size put on thin and warm, made in proportion of ½ pound of glue and same weight of alum dissolved in separate pails, then poured together.

Aquarium Cements.—

I.—Litharge	3 ounces
Fine white sand	3 ounces
Plaster of Paris	3 ounces
Rosin, in fine powder	1 ounce
Linseed oil, enough.	
Drier, enough.	

Mix the first three ingredients, add sufficient linseed oil to make a homogeneous paste, and then add a small quantity of drier. This should stand a few hours before it is used. It is said that glass joined to iron with this cement will break before it will come loose.

II.—Litharge	1 ounce
Fine white sand	1 ounce
Plaster of Paris	1 ounce
Manganese borate	20 grains
Rosin, in fine powder	3½ pounds
Linseed varnish oil, enough.	

III.—Take equal parts of flowers of sulphur, ammonium chloride, and iron filings, and mix thoroughly with boiled linseed oil. Finally, add enough white lead to form a thin paste.

IV.—Powdered graphite	6 parts
Slaked lime	3 parts
Barium sulphate	8 parts
Linseed varnish oil	7 parts

V.—Simply mix equal parts of white and red lead with a little kettle-boiled linseed oil.

Substitute for Cement on Grinder Disks.—A good substitute in place of glue or various kinds of cement for fastening emery cloth to the disks of grinders of the Gardner type is to heat or warm the disk and apply a thin coating of beeswax; then put the emery cloth in place and allow to set and cool under pressure.

Knockenplombe.—If 1 part of thymol be mixed with 2 parts of iodoform we obtain a substance that retains its fluidity down to 72° C. (161.6° F.). If the temperature be carried down to 60° C. (140° F.) it suddenly becomes solid and hard. If, in its liquid condition, this substance be mixed intimately with an equal quantity of calcined bone, it forms a cement that can be molded or kneaded into any shape, that, at the temperature of the body (98° F.), becomes as hard as stone, a fact that suggests many useful purposes to which the mixture may be put.

Cement for General Use.—Take gum arabic, 100 parts, by weight; starch, 75

parts by weight; white sugar, 21 parts, by weight; camphor, 4 parts by weight. Dissolve the gum arabic in a little water. On the other hand, dissolve the starch also in some water. When this is done add the sugar and the camphor and put in a water bath. Boil until a paste is formed, which must be rather thin, because it will thicken on cooling.

Strong Cement.—Pour over well-washed and cleaned casein 12½ parts of boiled linseed oil and the same amount of castor oil, put on the fire and bring to a boil; stir actively and add a small amount of a saturated aqueous solution of alum; remove from the fire and set aside. After standing a while a milky-looking fluid will separate at the bottom and rise to the top. This should be poured off and to the residue add 120 parts of rock-candy syrup and 6 parts of dextrine.

Syndeticon.—I.—Slake 100 parts of burnt lime with 50 parts of water, pour off the supernatant water; next, dissolve 60 parts of lump sugar in 160 parts of water, add to the solution 15 parts of the slaked lime, heat to 70° or 80° C. (158° to 176° F.), and set aside shaking frequently. Finally dissolve 50 to 60 parts of genuine Cologne glue in 250 parts of the clear solution.

II.—A solution of 10 parts gum arabic and 30 parts of sugar in 100 parts of soda water glass.

III.—A hot solution of 50 parts of Cologne glue in 60 parts of a 20-per-cent aqueous calcium-chloride solution.

IV.—A solution of 50 parts of Cologne glue in 60 parts of acetic acid.

V.—Soak isinglass (fish bladder) in acetic acid of 70 per cent until it swells up, then rub it up, adding a little water during the process.

"Shio Liao."—Under this name the Chinese manufacture an excellent cement which takes the place of glue, and with which gypsum, marble, porcelain, stone, and stoneware can be cemented. It consists of the following parts (by weight): Slaked powdered lime, 54 parts; powdered alum, 6 parts; and fresh, well-strained blood, 40 parts. These materials are stirred thoroughly until an intimately bound mass of the consistency of a more or less stiff salve is obtained. In paste form this mass is used as cement; in a liquid state it is employed for painting all sorts of articles which are to be rendered waterproof and durable. Cardboard covers, which are coated with it two or three times, become as hard as wood. The Chinese paint their houses with "shio liao" and glaze their barrels with it, in which they transport oil and other greasy substances.

LUTES.

Lutes always consist of a menstruum and dissolved or suspended solids, and they must not be attacked by the gases and liquids coming in contact with them. In some cases the constituents of the lute react to form a more strongly adhering mass.

The conditions of application are, in brief:

(*a*) Heating the composition to make it plastic until firmly fixed in place.

(*b*) Heating the surfaces.

(*c*) Applying the lute with water or a volatile solvent, which is allowed to volatilize.

(*d*) Moistening the surfaces with water, oil, etc. (the menstruum of the lute itself).

(*e*) Applying the lute in workable condition and the setting taking place by chemical reactions.

(*f*) Setting by hydration.

(*g*) Setting by oxidation.

These principles will be found to cover nearly all cases.

Joints should not be ill-fitting, depending upon the lute to do what the pipes or other parts of the apparatus should do. In most cases one part of the fitting should overlap the other, so as to make a small amount of the lute effective and to keep the parts of the apparatus rigid, as a luted joint is not supposed to be a particularly strong one, but rather one quickly applied, effective while in place and easily removed.

Very moderate amounts of the lute should be used, as large amounts are likely to develop cracks, be rubbed off, etc.

A classification may be given as follows:

(1) Plaster of Paris.
(2) Hydraulic cement.
(3) Clay.
(4) Lime.
(5) Asphalt and pitch.
(6) Rosin.
(7) Rubber.
(8) Linseed oil.
(9) Casein and albumen.
(10) Silicates of soda and oxychloride cements.
(11) Flour and starch.
(12) Miscellaneous, including core compounds.

I. Plaster of Paris is, of course, often used alone as a paste, which quickly